CRITERION
CATALYSTS & TECHNOLOGIES

TRANSFORMING ULSD ECONOMICS

The ability to produce diesel containing less than 10-ppm sulphur is no longer a differentiator in most markets. Progressive refiners are pushing to make ultra-low-sulphur diesel (ULSD) with improved fuel properties from tougher feedstocks and often within tight hydrogen budgets. Catalysts have a major role to play here. They have the power to transform diesel hydrotreating economics and turn ULSD units from cost centres into significant sources of profit.

TECHNOLOGY DEVELOPMENT

Over the past 10 years, Criterion Catalysts & Technologies (Criterion) has continually pushed the boundaries of hydroprocessing catalyst technology and raised hydrodesulphurisation (HDS) activity to ever higher levels (Figure 1). We have used our fundamental understanding of catalyst structure and behaviour, our catalyst manufacturing skills and our extensive commercial experience to launch a series of innovative catalysts. These have enabled us to keep pace with our customers' increasingly complex demands, as new clean fuels legislation has been introduced, competition has intensified and margins have come under sustained pressure.

Our current catalyst portfolio is founded on two technology platforms: ASCENT (now in its second generation) and CENTERA®. Both of these platforms can be used to formulate CoMo and NiMo catalysts; the former are ideal for low-severity-feed and hydrogen-constrained operations and the latter come into their own with more challenging feeds, for example, with higher end points, more cracked fractions and higher nitrogen levels, or where there is a requirement to upgrade diesel properties (cetane, cold flow, density, colour, etc.).

ASCENT catalysts have a mixture of Type I and II active sites and are generally suited to low- to moderate-pressure ULSD applications. They appeal to refiners seeking to strike the best balance between activity and hydrogen consumption; they are physically strong, which makes handling straightforward; and they are easily regenerated using low-cost, conventional one-step processes to give 90% or more of fresh catalyst activity.

CENTERA catalysts possess 100% Type II active sites and hence offer the highest possible level of activity. Well suited to moderate- to high-pressure ULSD units, they are made using advanced techniques that result in excellent activity retention (the active sites are locked into place) to provide refiners with outstanding operational flexibility.

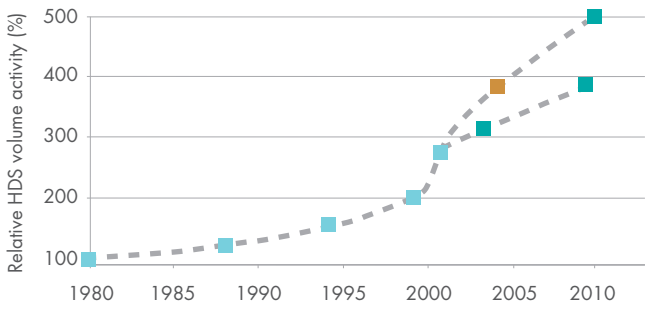

Figure 1: Criterion has continually pushed the boundaries of hydroprocessing catalyst technology and raised HDS activity ever higher.

OUR NEW FAMILY OF CATALYSTS BASED ON CENTERA TECHNOLOGY IS SETTING NEW PERFORMANCE STANDARDS.

CATALYST SELECTION

We work closely with refiners to select the most appropriate catalyst to meet their ULSD processing needs. This normally involves a detailed analysis in which reference will be made to feedstock quality; the target product specifications; product upgrading requirements; the reactor's design and normal operating regime; the amount of hydrogen available; the desired cycle length; and the refiner's preferences with regard to catalyst loading, process start-up and catalyst regeneration or reuse. From this analysis, we can determine the optimum ULSD process chemistry, which will define the best catalyst for the individual application. Some of the catalysts that currently feature most strongly in our portfolio are described on the right.

Experience has taught us that a single catalyst does not always provide the optimum solution for a given unit and that there can be a synergistic effect from combining or stacking CoMo and NiMo catalysts, whether based on ASCENT or CENTERA technology, in various proportions and configurations. The principle benefit comes in terms of increased activity compared with a straight CoMo catalyst without the additional hydrogen consumption normally associated with a NiMo catalyst.

This principle can be extended, depending on the unit design, to create the conditions required for enhanced aromatic saturation to meet difficult cetane, density and aromatic content targets in the ULSD unit. Essentially, the top part of the reactor bed is used to remove most of the sulphur and nitrogen from the feed and the lower part is used for aromatic saturation. For the best results, the reactor will be able to incorporate internal quench technology to maintain the temperature of the lower bed in the hydrogenation sweet spot where aromatic saturation is maximised.

ASCENT DC-2534

This is our highest-activity ASCENT CoMo catalyst. It is best suited to low- to moderate-pressure operations and provides refiners with a highly cost-effective means of extending run lengths or processing tougher feeds. It has excellent HDS selectivity (over aromatic saturation) and so provides the benefit of very low hydrogen consumption and sustained HDS performance at the end of the run in poor hydrogenation environments. It is very easy to use: it is readily regenerated by conventional means and it is extremely physically strong. This results in ease of handling and loading, and avoids yield loss during regeneration.

ASCENT DN-3531

A NiMo catalyst best suited to moderate- to high-pressure operations, this catalyst performs particularly well with tougher feedstocks. Its inherent hydrodenitrogenation and hydrodearomatisation (HDA) selectivity aid the desulphurisation of the most complex sulphur molecules. HDA activity also means that the catalyst can be used to upgrade diesel fuel properties such as cetane, density, aromatic content and colour. The catalyst shares the excellent physical and regeneration properties of the ASCENT CoMo catalyst DC-2534.

CENTERA DC-2618

The highest activity CoMo catalyst in our portfolio and the best option for treating difficult feeds in low- to moderate-pressure units with relatively low hydrogen consumption. Its superior activity may be used to extend cycle lengths, raise feedstock flexibility or overcome unit operating limitations.

CENTERA DN-3630

One of our highest-performing hydrotreating catalysts, best suited to moderate- to high-pressure operations that are severely activity constrained or where nitrogen removal and hydrogenation are ULSD limiting factors. The activity level makes the catalyst a genuine unit debottlenecker and its strong HDA selectivity means it can be used for serious improvements in aromatic-related diesel properties such as cetane, cold flow, density and colour.

PROOF POINT: **ALON'S BIG SPRING REFINERY**

The operators of Alon's Big Spring refinery in Texas, USA, approached Criterion when they were seeking to extend the cycle length of their ULSD unit and gain the flexibility to process heavier feeds: straight-run diesel and light cycle oil with higher cut points. To add to the challenge, the refinery has a limited supply of hydrogen. Working closely together, Alon and Criterion designed a stacked catalyst solution consisting of CENTERA CoMo, NiMo and CoMo catalysts. The result, without straining the refinery's hydrogen budget, is an increase in cycle length from 9 to 12 months and improved activity reflected in a reduced start-of-run temperature, which is being used, as planned, to increase feed severity. Significantly, the overall catalyst costs have fallen by 17%.

PROOF POINT: **MOTIVA ENTERPRISES' NORCO REFINERY**

Motiva Enterprises' Norco refinery in Louisiana, USA, has turned to ASCENT DC-2534 for ULSD production on the basis of its balanced performance. The benefits of using the catalyst can be illustrated by reference to the fact that weighted average bed temperature in the first part of the cycle is 4°C lower and hydrogen consumption is down 5% compared with previous cycles.

CONTACT US

For more information about how we can help you to enhance operational performance, meet increasingly stringent environmental regulations and increase revenues, visit us at **www.criterioncatalysts.com.**